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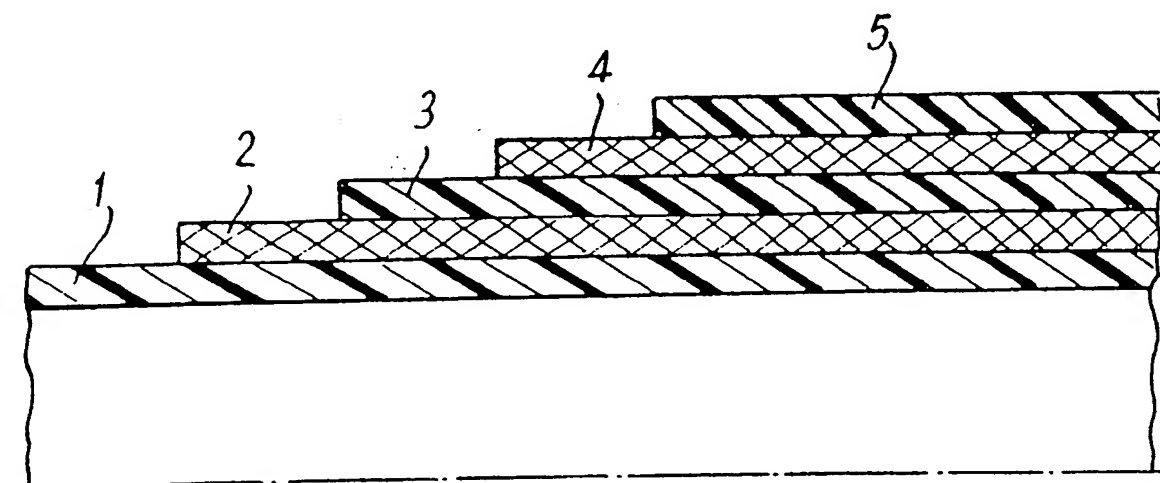
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(54) Tubular conduit

(57) A flexible tubular conduit including an inner tube 1 of flexible material, a first layer of reinforcing armouring 2 which ensures resistance to the mechanical stresses of pressure, tension and torsion, a protective coating 3 of flexible material and a second layer 4 of reinforcing armouring suited to resisting the internal pressure and surrounding the said protective coating. The conduit may be provided with a device for detecting the pressure between the armourings 2, 4 (see Figs. 3, 4 not shown).

Fig: 1



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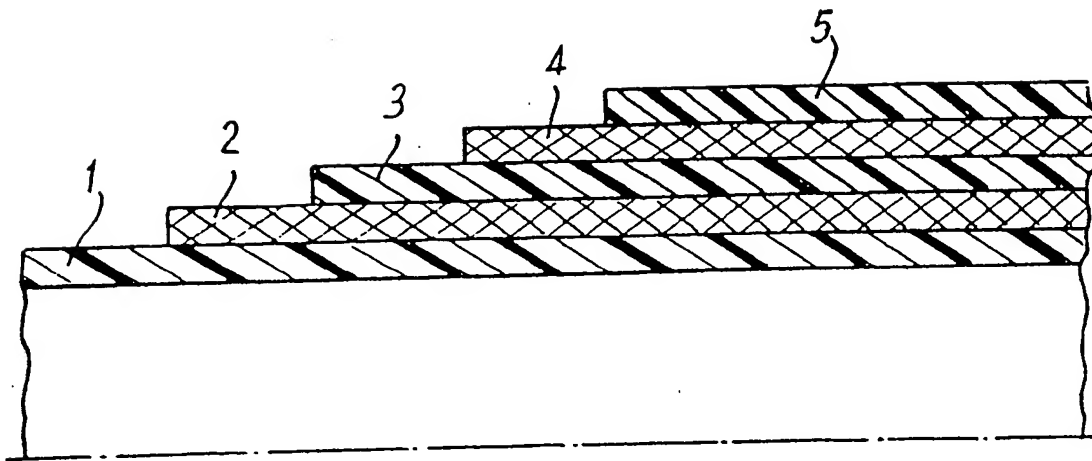
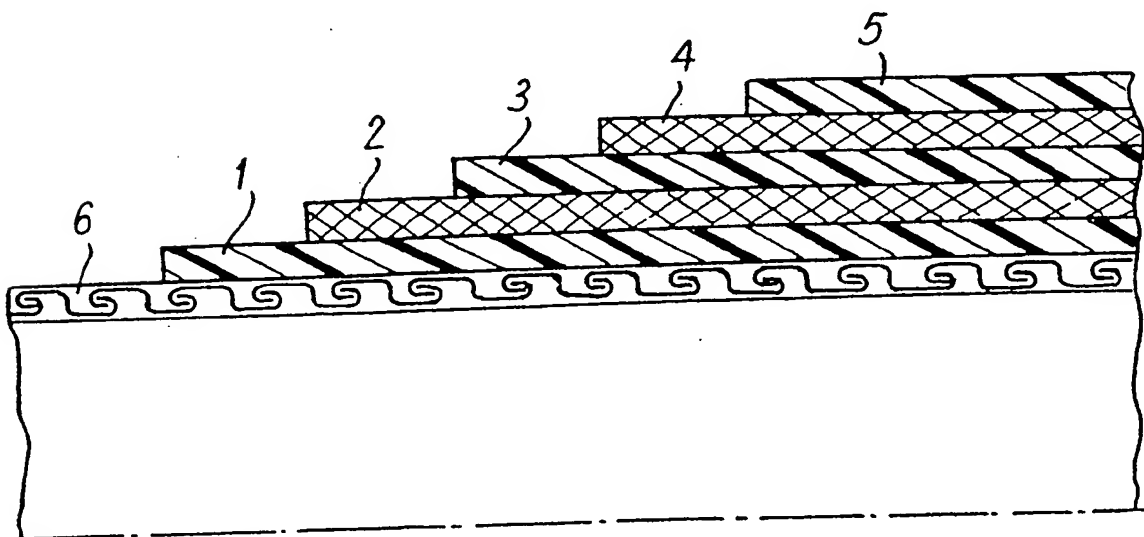
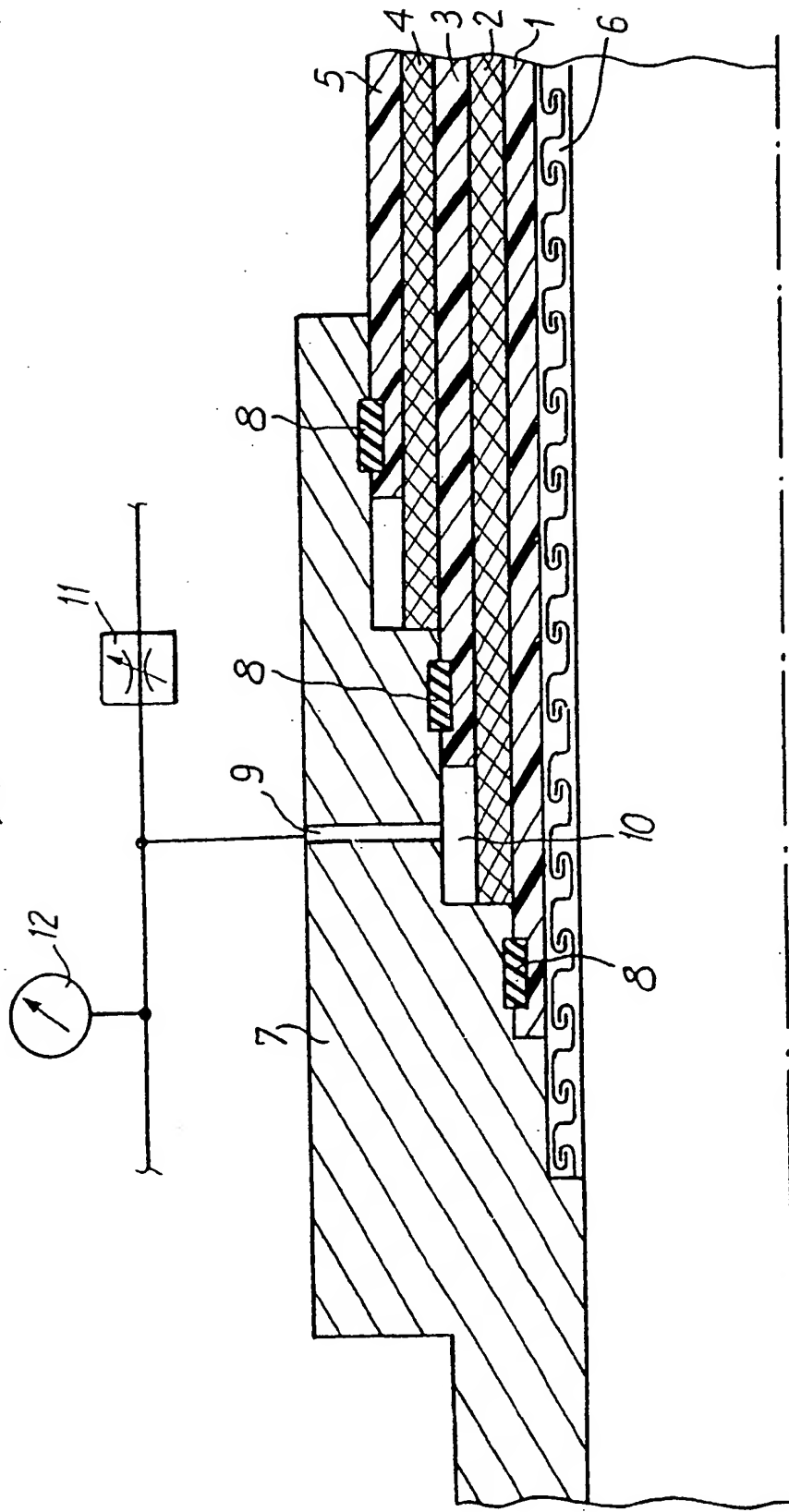
Fig: 1*Fig: 2*

Fig. 3



SPECIFICATION

Flexible tubular conduit

5 The present invention relates to a new flexible tubular conduit which may be employed in particular but not exclusively for the conveyance of hydrocarbons within the frame of the exploration of undersea wells. The flexible
10 tubular conduits in accordance with the invention may, however, be equally well employed in other applications, especially on land, for the conveyance of liquid, powdery or gaseous products.

15 Various types of flexible tubular conduit are already known. A first type of conduit called "smooth-bore" comprises an inner tube of flexible material intended to ensure tightness with respect to the product being conveyed, a
20 set of reinforcing armouring wound spirally or braided, which ensures resistance to the mechanical stresses of pressure, tension and torsion, the number, nature and arrangement of the armourings being defined as a function of the dimensions and of the use foreseen for the conduit, and finally an outer protective coating generally of flexible material such as polyethylene or a polyamide. Conduits of this type exhibiting particularly favourable mechanical characteristics are manufactured in great lengths by the Applicant company.

The latter likewise manufacture conduits of "rough-bore" type which besides the components described above include an inner metallic carcass intended for preventing crushing and to protect the flexible sealant sheath against attack by the products being conveyed.

In the case where the conduits are called
40 upon to convey gas, alone or associated with liquids and/or solids, in order to ensure the discharge of the gas which diffuses through the inner tube provision is made to render the outer coating permeable either through holes or by choosing a material having a permeability to gas, which is high with respect to that of the material of the inner tube. It is also known, to provide zones of weakness in the outer coating, especially grooves or blind
50 holes in order to form locations for bursting in the event of overpressure, to offer a preferential passage for the escape of the gas.

The outer protective coating is by its nature incapable of containing the internal pressure prevailing in the conduit in the event of accidental failure of the inner tube and/or the reinforcing armouring.

In this case there is a risk of the flexible conduit bursting with every imaginable consequence for safety, in particular when the fluid being conveyed is aggressive, inflammable or explosive.

The present invention has in view the provision of a flexible tubular conduit which
65 offers increased safety with respect to bursting,

avoiding in particular damage to the environment in the event of failure of the inner tube and/or of the reinforcing armouring arranged round it.

70 The flexible tubular conduit in accordance with the invention includes an inner tube of flexible material which ensures tightness with respect to the product being conveyed, a first layer of reinforcing armouring which ensures resistance to the mechanical stresses of pressure, tension and torsion, a protective coating of flexible material and a second layer of reinforcing armouring suited to resisting the internal pressure and surrounding the said protective coating.

80 If desired an outer protective sheath may be provided.

French Patent No. 2 119 266 shows a flexible tubular body which includes two sets of armouring. However, in this construction only the inner armouring exhibits a suitability for resisting the internal pressure, the outer armouring ensuring only resistance to tension and to torque. In the event of failure of the inner armouring under the effect of internal pressure the risk of bursting of the conduit cannot be avoided.

In the present invention, on the contrary, it is understood that the second layer of armouring achieves a second sealing barrier suited to retaining the internal pressure in the event of failure of the first layer of armouring or of the inner tube. The second layer of armouring may have any conventional structure for this type of application, which enables it to ensure the required functions of resistance to the stresses and tension and torsion and to resist in addition to the internal pressure.

The second layer of armouring may comprise a spiral structure which may be seamed or not, of one or more wires, for example, a carcass of metal ribbon or of steel section, two superimposed crossed layers of metallic sections, of flat or round cross-section or stranded, or else a spiral layer which may be seamed or not, associated with two superimposed crossed layers. Such structures are traditional and employed in particular in the conduits produced by the Applicant company.

115 In one particular advantageous embodiment of the invention the conduit includes a device for detection of the pressure between the inner tube and the second set of armouring.

This pressure detector device is advantageously connected to an alarm actuated in the event of detection of an overpressure corresponding with the destruction of the inner tube and/or of the first layer of armouring.

The simplest embodiment of the pressure detection device is a simple pressure connection associated with a pressure gauge.

In a particular advantageous construction when the fluid to be conveyed is a gas or contains gas, the conduit is arranged in order
130 to enable a discharge of leakage towards the

outside, of the gas diffusing through the inner tube, the detector device then being sensitive only to an overpressure which exceeds a pre-determined threshold level which corresponds

5 with the normal leakage flow, and then causing triggering of an alarm or the closure of valves provided upstream in the conduit.

A choke may also be provided, which is mounted in the leakage detector device and

10 calibrated in such a fashion that the flow of diffused gas passes through it without significant loss of pressure whereas the application of the full discharge from the conduit in the event of failure would bring about high losses

15 of pressure to be detected in the detector device.

In accordance with the invention the detector device may be arranged in the pipe itself or in an end ferrule in which the conduit is

20 mounted.

The invention can be performed in many ways and some embodiments will now be described by way of example and with reference to the accompanying drawings in which:

25 *Figure 1* is a diagrammatic section illustrating the structure of a first embodiment of conduit in accordance with the invention;

Figure 2 is a view similar to that in *Fig. 1*, illustrating a second embodiment of conduit;

30 *Figure 3* is a diagrammatic view illustrating an embodiment of a detector device associated with the conduit from *Fig. 2*; and

Figure 4 is a view similar to that in *Fig. 3*, illustrating a variant upon the detector device.

35 The "smooth-bore" type of conduit illustrated in *Fig. 1* comprises an inner tube of flexible sealant material, for example, polyamide or polyethylene.

Above this inner tube 1 is located a first

40 layer of armouring 2 represented only diagrammatically, which in practice comprises, for example, at least one layer of seamed spiral wires or two superimposed closed layers.

45 A protective coating generally of flexible material such as polyamide or polyethylene 3 surrounds the layer of armouring 2. Structures of flexible conduit which include the three components described below are at present

50 produced commercially in great lengths by the Applicant company.

In accordance with the invention there is located round the coating 3 a second layer of

55 armouring 4 of the same structure as the layer of armouring 2 or of a different structure.

In the example illustrated the layer of armouring 4 comprises two superimposed crossed layers of steel wire.

Finally an outer protective sheath 5 which if

60 the occasion arises might be omitted, is located round the second layer of armouring.

The structure of the flexible conduit illustrated in *Fig. 2* is of "rough-bore" type and comprises besides the components described

65 for the structure from *Fig. 1*, a spiral inner

cracase 6.

In this embodiment once again the layers of armouring 2 and 4 may exhibit the same structure or different structures and these

70 structures may be the same as those of the layers of armouring of the conduit from *Fig. 1* or else be different.

In *Figs. 3* and *4* the structure of flexible conduit illustrated in *Fig. 2* is shown mounted

75 in a connector ferrule 7 with the interposition of sealing rings 8 between the coatings or sheets 1, 3 and 5 of the conduit and the facing bearing surfaces on the ferrule 7. A hollow 9 provided in the ferrule 7 communicates with an annular space 10 outside the

80 first layer of armouring 2. The leakage detector device comprises a choke 11 in the package for the flow of the diffused gas and a guage 12 which detects the pressure prevailing

85 in the annular space 10.

The choke is calibrated in such a fashion that the flow of diffused gas passes through it without significant loss of pressure whereas the application of the full delivery from the

90 conduit, especially in the event of damage to the set of armouring 2, brings about a high loss of pressure.

In the embodiment as *Fig. 4* a detector device is illustrated which comprises besides

95 the choke 11 and the pressure guage 12 a regulator 13 which directs the different gases to the open air (the position represented in the *Figure*) and which in the event of a heavy discharge changes its position (the action being controlled by the control line shown in

100 broken lines) in order to direct the leakage flow towards a storage tank 14.

An adjustable pressure-switch 15 in the event of overpressure actuates an alarm 16

105 fed by a battery 17. This switch may likewise actuate the closure of valves (not shown) which lie upstream in the flexible conduit, so as to drop the pressure prevailing in the conduit.

110 Although the invention has been described in connection with particular embodiments it is quite obvious that it is in no way restricted and that numerous variants in form and material may be applied to it without for all that

115 departing either from its scope or from its spirit.

CLAIMS

1. A flexible tubular conduit, characterized in that it includes an inner tube of flexible material which ensures tightness with respect to the product being conveyed, a first layer of reinforcing armouring which ensures resistance to the mechanical stresses of pressure,

120 tension and torsion, a protective coating of flexible material and a second layer of reinforcing armouring suited to resisting the internal pressure and surrounding the said protective coating.

130 2. A flexible tubular conduit as claimed in

claim 1, characterized in that it includes round the second layer of reinforcing armouring an outer protective sheath.

5 3. A flexible tubular conduit as claimed in claim 1 or claim 2, characterised in that it includes an inner metallic carcase.

4. A flexible tubular conduit as claimed in any one of the preceding claims, characterised in that the second layer of reinforcing armour-
10 ing exhibits the same structure as the first layer of reinforcing armouring.

5. A flexible tubular conduit as claimed in any one of the preceding claims characterised in that it includes a device for detection of the
15 pressure between the inner tube and the second layer of armouring, the said device being arranged in order in normal operation, to ensure passing of the gas which diffuses through the inner tube.

20 6. A flexible tubular conduit as claimed in claim 5, characterised in that the detector device is connected to an alarm.

7. A flexible tubular conduit as claimed in claim 5 or claim 6 characterised in that the
25 detector device is associated with means of closure of valves arranged upstream in the conduit.

8. A flexible tubular conduit substantially as described herein with reference to and as
30 shown in Fig. 1, Fig. 2 and Figs. 3 and 4 of the accompanying drawings.